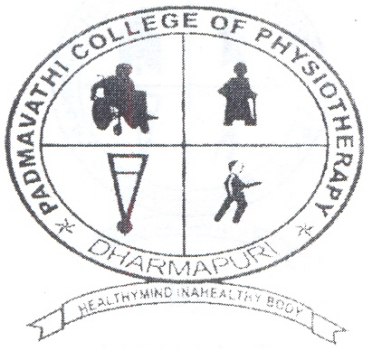
THE EFFECTS OF AXILLARY METHODS OFC THERAPEUTIC ULTRASOUND APPLICATION OVER ANTERIOR METHOD AS AN ADJUNT IN CHRONIC ADHESIVE CAPSULITIS OF GLENOHUMERAL JOINT -- A COMPARATIVE STUDY



By

(Reg. No . 27101802)

PADMAVATH COLLEGE OF PHYSIOTHERAPY

PERIYANAHALLI

DHARMAPURI

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Under the guidance of

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Associate Professor,

Padmavathi College of Physiotherapy

Submitted in Partial fulfillment of the requirements for the

Degree of **Master of Physiotherapy**

From

The Tamilnadu Dr. M.G.R. Medical University,

Chennai

PADMAVATH COLLEGE OF PHYSIOTHERAPY

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CERTIFICATE

This is to certify that the project entitled **"THE EFFECTS OF AXILLARY METHODS OFC THERAPEUTIC ULTRASOUND APPLICATION OVER ANTERIOR METHOD AS AN ADJUNT IN CHRONIC ADHESIVE CAPSULITIS OF GLENOHUMERAL JOINT -- A COMPARATIVE STUDY"**

Submitted by the candidate

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is a bonafide work done in partial fulfillment of the requirements for the Degree of **Master of Physiotherapy** from

The Tamilnadu Dr. M.G.R. Medical University,

Chennai

Guide **Principal**

Viva-voce Examination held on _____

Internal Examiner **External Examiner**

DECLARATION

I hereby declare and present my dissertation entitled entitled **"THE EFFECTS OF AXILLARY METHODS OFC THERAPEUTIC ULTRASOUND APPLICATION OVER ANTERIOR METHOD AS AN ADJUNT IN CHRONIC ADHESIVE CAPSULITIS OF GLENOHUMERAL JOINT -- A COMPARATIVE STUDY"** the outcome of the original research work undertaken and carried out be me , under the guidance of **Mr. J. RAVI SHANKAR, M.P.T. , MIAP.,** Associate Professor , Padmavathi College of Physiotherapy, Periyanahalli, Dharmapuri , Tamilnadu.

I also declare that the material of this dissertation had not formed in any basis for the award of any other Degree previously from the Tamilnadu Dr. M.G.R. Medical University, Chennai.

(LENIN SAMUEL VARGHESE)

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(LENIN SAMUEL VARGHESE)

DEDICATED TO MY BELOVED

PARENTS , STAFFS

AND

LOVABLE FRIENDS

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INTRODUCTION

In the process of evolution from quadripeds to bipeds, the forelimbs developed into upper limb, which transformed the appendage from weight bearing and ambulations to prehension and manipulation. The cortical area, controlling shoulder function enlarged and shoulder improved in precise motion, co-ordination, strength and endurance assisting the upper limb functions. The upper limb contains one of the principal features separating humans from the rest of the animal world the human hand. The intricate, gross and skilled functions of the hand are dependent on the mobile yet strong base provided by the shoulder complex.

The shoulder complex consists of 3 bones viz., clavide, scapula and humerus and five articulations namely sterno clavicular joint, acromioclavicular joint, gleno humeral joint, scapulothoracic joint and suprahumeral joint. Shoulder complex is one of the most commonly affected site in various diseases or disorders and adhesive capsulitis of the gleno humeral joint is the most common condition which is treated in a physiotherapy department.

A frozen shoulder (adhesive capsulitis) is glenohumeral joint with pain and stiffness that cannot be explained on the basis of joint incongruity. Since first described by Duply in 1872, considerable ambiguity exists regarding etiology and pathology of this disease. But there is definite evidence of capsular involvement with adhesion formation and contracture. Histologic events that could result in the loss of capsular extensibility may include abnormal cross bridging between newly synthesized collagen fibres and preexisting fibers, and loss of critical fiber distance caused by a significant decrease in hyal uronic acid and water content. Also authors have described a post immobilization fatty fibrous connective tissue scar, creating intra-articular adhesions within synovial joints, which could also result in decreased mobility.

Shoulder pain of insidious onset, progressive loss of both active and passive range of motion, and a capsulitis. Women are more affected than men. Usually seen between 4^{th} to 7^{th} decades. There are 3 clinical phases of this condition viz., (i). A painful phase (ii) A phase of progressive stiffness (iii) A thawing phase with gradual return to motion. The natural history of this disease has been described by typically lasting 18 to 24 months. But the amount of disability and pain caused by this syndrome is highly variable and

many patients are not willing to wait the many months or years to see whether this syndrome will resolve by it self.

Treatment recommendations for this condition are analgesic and anti-inflammatory medications, steroid injections, manipulation under anesthesia, open relase of adhesions and physiotherapy. Although physical modalities are used in the treatment. A lot of manipulations and mobilization techniques are put forwarded by various clinicians and use of ultrasound and short wave diathermy as adjuncts have been well supported in the literature and by research studies.

In this study, the effect of continous therapeutic ultra-sound application in axillary method is compared over anterior method as an adjunct therapy in chronic adhesive capsulitis of glenohumeral joint.

The assumptions of this study include,

- In adhesive capsulitis there in involvement of glenohumeral joint capsule with adhesion formation and contractive, which causes a capsular pattern of restriction of glenohumeral motion.
- Adhesion formation mainly occurs in the dependent inferior axillary pouch of the capsule.

- Therapeutic ultrasound application via axilla is the best and easiest acess to the seat of actual defect i.e., inferior axillary pouch.
- The localized deep heating effect of continuous ultrasound increases the extensibility of contracted capsule and helps easy breakage of adhesions of the capsule ultimately contributing normal joint function.

The outcome measures taken for this study are, shoulder pain measured using visual analogue scale, range of motion of shoulder measured using a goniometer and shoulder function measured using Rowe's shoulder functional evaluation form.

Although some therapists are using axillary method of ultrasound application in the treatment of adhesive capsulitis, a scientific study regarding the effectiveness of this method of treatment is currently not available.

Hence this study is aimed at comparing the effectiveness of therapeutic ultrasound application in axillary method over anterior method as an adjunct therapy in chronic adhesive capsulitis of glenohumeral joint.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

I. Review of literature related to anatomy of axilla, glenohumeral joint capsule and inferior axillary pouch.

- ***JSP Lumley et al (1995)*** the axilla is a fat filled space between the lateral thoracic wall and the upper limb. Its shape is that of a truncated pyramid with apex, base and four walls.

Apex : This is bounded by the superior border of the scapula, the coracoid process, the outer border of the 1st rib and the middle third of the clavicle. Through it the axilla communicates with the posterior triangle of the neck. The cervico axillary canal transmits the axillary vessel and the brachial plexus.

Base : This is formed by axillary fascia, subcutaneous tissue and skin.

Anterior wall : This contains superficially pectoralis major and deep to this is pectoralis minor enclosed in the clavipectoral fascia.

Posterior wall : This extends lower than the anterior and is composed of subscapularis, latissimus dorsi and teres major form above down wards.

Medical wall: This comprises the upper limbs and intercostals spaces, these structures being covered by slips of serratus anterior.

Lateral wall : The narrow intertubercular groove of the humerus, into the lips of which, muscles of the anterior and posterior walls are inserted.

Contents

a) Axillary artery and vein.
b) Cards and terminal branches of brachial plexus.
c) Coraco brachialis and biceps.
d) Axillary lymphnodes and vessels.
e) Fat

- ***Robert Donatelli (1994)*** the glenohumeral joint capsule is relatively thin, allowing approximately one half inch of joint distraction in a dissected specimen. The joint capsule is reinforced superiorly and anteriorly by the coracohumeral and glenohumeral ligaments, respectively. The rotator cuff muscles also reinforces in the joint capsule. The inferior aspect of the joint

is not reinforced by muscles or capsule ligaments making it the weakest area.

- ***J.S.P. Lumley et al (1995)*** shoulder joint capsule is strong but lax, especially inferiory by attached proximally to the glenoided labrum and distally to the articular margin of the head of the humerus, except inferiorly where it encroaches for 1-3 cm on to the neck of the bone.

- ***Dena Gardiner (1985)*** states " if a portion of the capsule is slack and prone to fall into folds, adhesions from very readily and glue there folds into tucks, these fore the knee joint is rested for example, in 20 degrees of flexion and the shoulder joint is partially abducted.

II. Review of literature related to the involvement of inferior axillary pouch in adhesive capsulitis.

- Hernicus et al (2000 APTA Journal) says ' the axillary recess, a pouch of the glenohumeral capsule evolving from the inferior rim of glenoid cavity to the inferior part of the humeral head, in occur opinion, plays an important role in adhesive capsulitis.

- Risk et al (1994) noted a loss of joint volume due to constricted capsule and obliterations of the subscapular or axillary recess.

- Pollock et al (1994) stated that a contracted glenohumeral joint capsule is the primary structure responsible for frozen shoulder.

- Uitvlugt et al (1993) performed diagnostic glenohumeral joint arthroscopy. The pathology documented were vascular synovitis in all cases with capsular contracture primarily in the anterior and inferior capsule.

- Ozaki et al (1989) found a diminished joint capacity and restricted inferior axillary fold and subscapsular bursa in 17 patients with frozen shoulder due to a shortened coraco humeral ligament.

- De Palma (1983) stated that the pathologic process of frozen shoulder primarily involves the fibrous capsule of 14 frozen and 13 normal shoulders. He found an increased amount of hexosamine in the frozen shoulder as compared with normal shoulders? This difference was caused by an increase in the total content of glycosaminoglycans (UAG) namely, an increase in

herparan sulpate, chanbdroitin -6-0 sulphate and dermaton surface and a decrease in hyal uronic acid in the frozen shoulders.

- Reeve's (1960) study confirms that the strength of the anterior inferior capsule and capsular ligament decreases with age, especially in the 5th decade. He substantiated the capsular pattern in arthrograms of 17 patients with frozen shoulder.

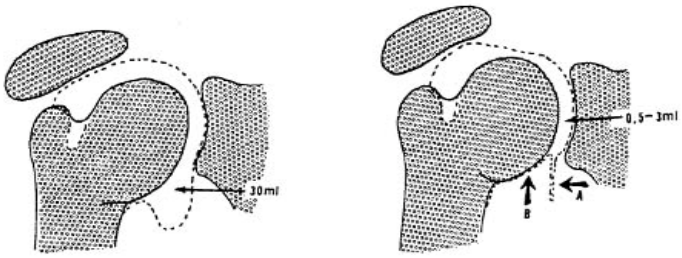
- Thompson and compere (1959) states when the arms is held in adduction, there is a great tendency for the redundant shoulder capsular to become adherent.

- Me Laughlin (1958) in his surgical explorations found no histological evidence of inflammation but consistently found that there was loss of inferior folds of joint capsule.

- Neviaser (1945) described a condition adhesive capsulitis that included a thickened, fibrotic glenohumeral joint capsule adhered into humeral head and an obliteration of the capsular axillary pouch. He

demonstrated that severing the inferior capsule and the adhesions, relieved the restricted glenohumeral motions.

Cailliet R. (1992)



The normal capsule permits injections of at least 30 ml of air. In adhesive capculitis, the capsule adheres to itself (A) and to the humeral head (B). This decreases capacity to 0.5 to 3 ml and markedly limits range of motion.

III. Review of literature related to pain in adhesive capsulitis

- **Cyriax (1978)** classified frozen shoulder into 3 stages. The first stage exists when the pain is confined to the deltoid area or at least does not extend distal to the elbow, when the patient can lie on the in valued extremity at night, when pain is present only with movement and when the end feel is elastic. The second stage is present if only some of the criteria in

the first stage are met. The third stage is characterized by severe pain extending from the shoulder to the forearm and wrist, inability to lie on the involed extremity at night, pain at rest and greatest at night and an abrupt end feel.

- **Cyriax J. (1978)** if the condition is more advanced, the patient may complain of plain spreading from the shoulder down the forearm, upto the cervical spine, and into the ipsilateral scapula and pain at rest.

- **Murry (1960)** The abnormal scapular position can cause stretch weakness of the thomboids and levator scapulae tightness, giving rise to local pain.

- **Elvey (1986)** Because cervical spine dysfunction can refer pain to the shoulder, this area must be assessed. The integrity of brachial plexus must be evaluated in case of shoulder pain.

- **Michelle H. Cameron (1999)** A simple visual analog scale may be sufficient to provide information regarding a progressive decrease in pain.

IV. Review of literature related to range of motion restriction in adhesive capsulitis.

- **Hernicus et al (2000. APTA Journal)** says " We believe that capsular adhesions of the recess hinder normal expansion during abduction resulting in diminished active and passive mobility of the shoulder.

- **Michelle H. CAMERON (1999)** A capsular pattern of restriction is the specific combination of motion loss that is caused by shortening of the joint capsule surrounding a joint. Each synovial joint has a unique capsular pattern of restriction. Capsular pattern for the glenohumeral joint involves restriction of external rotation, abduction, internal rotation and flexion to progressively smaller disease. Capsular patterns may be caused by the effusions, fibrosis or inflammation commonly associated with degenerative joint decrease, arthritis immobilization and acute trauma.

- **Cyriax (1978)** clarifies that arthritis exhibits limitation of passive motion in characteristic proportions, which he calls the capsular pattern.

- **Robert A Donatelli (1987)** Based on arthrokinematics of shoulder motion, it follows that if the anterior capsule were more contracted external

rotation will be more limited. In addition abduction would be limited by the loss of the inferior redundant fold and limited external rotation.

- **Grubbs N. (1993)** states adhesive capsulitis of shoulder, which includes shortening of the glenohumeral joint capsule and elimination of inferior axillary fold will restrict both passive and active shoulder range of motion in a capsular pattern.

- **Robert A. Donatelli (1987)** The capsular pattern of frozen shoulder is most limited in external rotation, followed by abduction and then by internal rotation.

- **Reeves (1960)** substantiated the capsular pattern in athrograms of 17 patients with frozen shoulder.

- **Gray (1978)** noted that 24 of 25 patients regained normal glenohumeral motion within 2 years from the onset of symptoms.

- **Simon (1975)** emphasized simply out waiting the condition does not assure the patients a full painless ROM.

- **Michelle H. Cameron (1999)** In adhesive capsulitis treatment should be directed at increasing the extensibility and length of the shortened tissues, particularly the anterior inferior capsule of the glenohumerial joint.

V. Review of literature related to functional limitation and disability in adhesive capsulitis.

- **Murry (1960)** Initial observation of the patient frequently reveals a stooped posture with rounded shoulders, the involved extremity is adducted and internally roated, resting in the patients lap. In gait the arm swing is usually limited or absent on the affected side. The patients shirt is usually removed as through the arm were in a cast.

- **Cailliet R. (1981)** Pain motivates the patient with adhesive capsulitis to seek medical attention as does function of the extremity.

- Ozaki J.et at (1989) functionally the patient will be unable to sleep on the affected side, hook a brassiere in the back, comb the hair, or reach for a wallet in a back pocket.

- Robert A. Donatelli (1987) the patient cannot recall an injury and frequently is unable to determine when the pain and loss of function frozen.

VI. Review of literature related to effectiveness of ultrasound therapy in adhesive capsulitis.

- **Michelle H. Cameron (1999)** says- ultrasound is particularly well suited to heating joint capsule in adhesive capsulitis as ultrasound absorption coefficient of the capsule is more and it reaches more deeply and heats smaller areas than most superficial heating agents, while not over heating the overlying fat. The increased ease of stretching is thought to be the result of altered viscoelasticity of collagen and alteration of the collagen matrix.

- **Cyriax (1978)** recommended heating the joint capsule prior stretching, because increased circulation acts as an analgesic. The analgesics effect however tends to be temporary.

- **Chapman CE and Staford PW(2001 APTA Journal)** says 'It is suggested that therapeutic ultrasound is one of the rehabilitation interventions that is selectively effective depending on the condition treated or the characteristic of therapeutic application.

- **Michelle H. Cameron (1999)**

\Physical agents that increase deep tissue temperature, such as ultrasound and short wave diathermy should be used prior to stretching deep soft tissues.

- **Lentell G. Hetherington T. et al(1992)**

  Physical agents that increase deep tissue temperature may be used as components of the treatment of motion, restriction because they can increase soft tissue extensibility, thereby decreasing the force required to increase tissue length and increasing the risk of injury during the stretching procedure.

- **LehwalnnL et al (1970)**

  Applying physical agents to soft tissue prior to prolonged stretching can alter the visco elasticity of fibres, allowing plastic deformation to occur.

- **Michelle H. Cameron (1999)**

  - Ultra sound is particulary well suited to heating tendons ligaments, joint capsules and fasc while not over heating overlying fat.

- Since ultrasound can penetrate to the depth of most joint capsules, tendons and ligaments and since these tissues have high ultrasound obsorption coefficients, ultrasound can an effective physical agent for heating these tissues prior to stretching.
- The treatment parameters found to be effective are 1 or 3 MHz frequency, depending on the tissue depth, at 1.0 to 2.5 w/cm^2 intensity applied for 5 to 10 minutes after ultrasound application while the tissue is cooling.
- Ultrasound may control pain by altering its transmission or perception or by modifying the undergoing condition causing pain. These effects may be the result of stimulation of the cutaneous thermal receptors and/or increased soft tissue extensibility due to increased tissue temperature or the nonthermal effects of ultrasound or the result of modulation of inflammation due to the nonthermal effects of ultrasound.

- **Middle Waste S.Chetterjee (1978)**

  Studies have shown that ultrasound can be more effective in controlling pain than placebo ultrasound or treatment with other

thermal agents, and that the addition of ultrasound to an exercise programme can further improve pain relief.

- **Harvey W et al (1975)**

  Continuous ultrasound applied at 1.5 w/cm2 for 3 to 5 minutes for 10 treatments over a 3 week period followed by exercise has been found to be more effective than exercise alone in relieving pain and increasing range of motion in patients with shoulder pain.

- **Michelle H. Cameron (1999)**

  Decision making concerning ultrasound treatment parameters.

  Impairments

  Effect of ultrasound

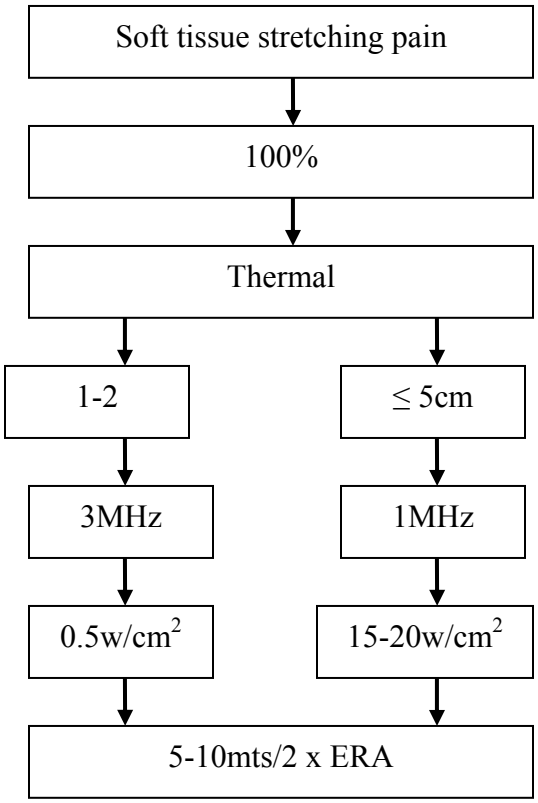
  Duly of problem

  Depth of problem

  Ultrasound intensity

  Ultrasound frequency

  Duration of treatment



VII. Review of literature related to procedure and site of application of ultrasound in adhesive capsulitis.

- **Robert A. Donatelli (*1987)*** States –with the inferior capsule so frequently involved to frozen shoulder, while applying ultrasound, the extremity may need to be positioned in abduction and external rotation to reach the inferior portion effectively. Any portion of the capsule can be treated specifically with proper positioning of the joint. The therapist may also put the target capsule on stretch as ultrasound is applied.

- **Stanley (1972)** advocated the use of ultrasound via axilla over antero inferior border of the capsule to be capsule to be closer to the seat of actual defect.

MATERIALS AND METHODOLOGY

AIM

To assess the efficacy of axillary method of therapeutic ultrasound application as an adjunct therapy in chronic adhesive capsulitis of glenohumeral joint.

OBJECTIVES

1) To study the efficacy of anterior method of therapeutic ultrasound application in the treatment of chronic adhesive capsulitis of glenohumeral joint.

2) To study the efficacy of axillary method of therapeutic ultrasound application in the treatment of chronic adhesive capsulitis of glenohumeral joint.

3) To compare the efficacy of axillary method with anterioe method of therapeutic ultrasound application in chronic adhesive capsulitis of glenohumeral joint.

HYPOTHESES

Null Hypotheses

i) There is no significant improvement interms of reduction of pain in axillary method over anterior method of therapeutic ultrasound application in chronic adhesive casulitis of glenohumeral joint.

ii) There is no significant improvement in terms of gain in range of motion in axillary method over anterior method of therapeutic ultrasound application in chronic adhesive capsulitis of glenohumeral joint.

iii) There is no significant improvement in terms of shoulder function in axillary method over anterior method of therapeutic ultrasound application in chronic adhesive capsulitis of glenohumeral joint.

Alternate Hypotheses

i) There is no significant improvement interms of reduction of pain in axillary method over anterior method of therapeutic ultrasound application in chronic adhesive capsulitis of glenohumeral joint.

ii) There is no significant improvement interms of gain in range of motion in axillary method over anterior method of therapeutic ultrasound application in chronic adhesive capsulitis of glenohumeral joint.

iii) There is significant improvement in terms of shoulder function in axillary method over anterior method of therapeutic ultrasound application in chronic adhesive capsulitis of glenohumeral joint.

RESEARCH DESIGN

It is an experimental comparative study.

Population Studied

24 subjects were selected using consecutive sampling into two groups i,e., experimental group and control group with 12 patients each. From patients referred to physiotherapy department with a diagnosis of adhesive capsulitis of glenohumeral joint by orthopaedic surgeons. The study was conducted at the Dept. of physiotherapy, Metropolitan Hospital, Thrissur from April 15, 2002 to july 15,2002.

Inclusion Criteria

1. Diagnosis by orthopaedic surgeon.
2. Restriction of both active and passive range of motion.
3. Insidious onset of the condition.

4. Capsular pattern of restriction.
5. Positive capsular stretch test.
6. 3 months to one year duration of symptoms.
7. Movement restriction in all planes by atleast 25%.
8. Patients with age between 40 to 70 years.

Exclusion Criteria

1. Presence of diabetes.
2. Presence of cardiac and neurologic problem which interference with the physiotherapy programme.
3. History of recent trauma, Surgery or dislocation of the shoulder.
4. History of steroid injections and manipulation under anesthesia of shoulder.
5. History of previous physiotherapy treatment for frozen shoulder.
6. Presence of cervical spine disorders or poly arthritis
7. Radiological evidence of soft tissue calcification, osteoarthritis or fracture.
8. Presence of resting pain or radiating pain.

9. Others painful shoulder conditions like acromioclavicular joint arthritis, rotator cuff pathologics shoulder hand syndrome, brachio neuralgic etc.
10. Presence of communication defects.
11. Un-co-operative patients.

Sampling Method

Random cause consecutive sampling.

MEASUREMENT TOOLS

1. Visual Analogue scale (VAS)

Visual analogue scale was used to measure pain/discomfort at and around shoulder joint. Patient was asked to mark the point where he rated his while doing shoulder movements. Two measures were taken the treatment value on day one before treatment was commenced and post treatment value, after the treatment was over, Score 0 = no pain, 10 = unbearable pain.

(No Pain) (Unbearable pain)

2. *Goniometer*

It was a plastic half circle (180^0) goniometer manufactured by Hitra equipment, Bombay. It was used to measure range of motion of shoulder before and after the treatment.

3. ***Rowe's functional evaluation from***

It was used to measure the functional evaluation score of shoulder. It measures five aspects of shoulder function namely pain, stability function, motion and strength. The score was measured on a scale pf 0 to 100 points maximum, before and after treatment.

(Rowe's functional evaluation from- please refer appendix III)

OUT COME MEASURES TAKEN FOR STUDY

1. Shoulder pain

Shoulder pain was measured using visual analogue scale before after treatment.

2. Range of motion of shoulder

Both active and passive range of motion of abduction and external rotation were measured before and after the treatment. These ranges were used as these ranges are the most affected motions on adhesive capsulitis.

For measuring external rotation the patient was poaitional supine. The arms were kept adducted and elbow flexed with forearm mid prone. With the axis at the olecranon process, the movable arm was kept along the ulna and the stable arm horizontal to bed.

For measuring abduction the patient was positioned in standing. This was kept one inch below the acromion process on the posterior aspect. Mobile arm was kept along the humerus and stationary arm perpendicular to the floor.

All active range of motion measures were taken after a trial attempt by the patients passive ranges were measured after active range of motion. All measurements were taken thrice and the mean used for calculations.

3. Shoulder function

It was measured using the Rowe's shoulder functional evaluation form. The score was measured on a scale of 0 to 100 points maximum before and after treatment.

MATERIALS

1. Ultrasound theropy Unit

Technical specifications

Company	- Electrocare systems and services
Model	- 1997
Ultrasound norminal frequency	- 1 Mhz
Mode of operation	- Continuous and pulsed
Pulse ratios	- 1:1, 1:4, 1:7, 1:10
Treatment time	- 0-60 mts
Timer	- Electronic timer with digital display
Alarm	- Audio alarm
Power input	- 200 V, 50Hz. AC

2. Ultrasound Transmission gel

Company – Jaay Vee Meditech International Pondicherry

3. Scissors, Disposible shaving set, shaving cream, after shave lotion, cotton

4. Pen, paper, pencil, eraser, scale

5. Recording sheets with basic evaluation form, data collection sheets with facility to record active and passive range of motion, score on visual analogue scale functional evaluation score. (please refer appendix)

EXPERIMENTAL GROUP

The experimental group consists of 12 patients.

Male patients	-	6
Female patients	-	6
Mean age	-	52.7 years
Mean duration	-	5.7 months

Procedure

A detailed assessment of each patient his taken with emphasis on frozen shoulder evalution. They are given therapeutic ultrasound via axilla, passive capsular stretching and active exercise as home programme.

Treatment protocol for experimental group

1) Therapeutic ultrasound (Via axilla)

- Mhz
- 2w/cm2
- Continuous mode
- 6 mnts

2) Passive capsular stretching exercises

Supine
- Inferior capsular stretch
- Anterior capsular stretch
- Posterior capsular stretch

Prone
- Anterior capsular stretch
- Inferior capsular stretch

6 seconds hold 3 repetitions each

3) Active shoulder exercises

- Shoulder wheel
- Finger ladder
- Towel exercises
- Butterfly exercise

10 repetitions each

4) Home Programme

Same as (3) except that instead of shoulder wheel.

10 repetitions each twice daily

Treatment is given for a total of 45 minutes for continuous 10 days. Pain, range of motion and shoulder functional evaluation score were measured before and after the treatment.

Technique of ultrasound application via axilla

Patient is positioned in supine lying. Axillary hair is removed either using scissors or a disposable shaving set. The affected shoulder is kept in maximum available flexion, abduction and external rotation with elbow in flexion. If possible hand behind neck position. Ultrasound transmission gel is applied on the axilla and on the transducer head. A small transducer head is preferred ultrasound is applied the axilla for 6 minutes in a continuous mode at 2 w/cm^2 intensity. A mild stretch on the inferior capsule is maintained during ultrasound application by applying a passive downward pressure at the flexed elbow within the limits of pain.

Passive capsular stretching exercises are carried out immediately after ultrasound application, before the heating effect subsides.

CONTROL GROUP

The control group consists of 12 patients

Male patients	-	7
Female patients	-	5
Mean age	-	57.7 years
Mean duration	-	6.0 months

Procedure

Same procedure are experimental group except that therapeutic ultrasound is applied anteriorly to the shoulder joint in sitting position. Treatment protocol for control group is the same as experimental group.

STATISTICAL ANALYSIS

INTRODUCTION

The data collrcted for the study were statistically analysed for comparing the effectiveness of axillary method and anterior method of therapeutic ultrasound application.

Chi-squared (x^2) test

This test is used to find out whether there is any significant difference between the subjects in experimental or control group in terms of age, sex, duration of condition and side of involvement

$$X^2 = \frac{N\left((AD - BC) - \frac{N}{2}\right)^2}{(A+B)(C+D)(A+C)(B+D)}$$

Where, N is the total no of subjects.

Student test

Control and experimental group responses to the treatment were analysed using

paired test

The formulae used is

$$t = \frac{d\sqrt{n}}{SD}$$

$$Sd = \sqrt{\frac{\sum d^2 - n(\bar{d})^2}{n-1}}$$

Where,

n = no. of patients

Sd = standard deviation

d=difference between the initial and final reading

d = mean difference between the initial and final values

For comparing control groups response aver experiment groups response towards treatment, ie., for comparing the effectiveness of axillary method and anterior method ultrasound application, **unpaired test** was used.

The formula is

$$t = \frac{x_1 - x_2}{S}\sqrt{\frac{n_1 n_2}{n_1 + n_2}}$$

$$S = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}$$

$$s_2 = \sqrt{\frac{\sum X_2^2 - n_2(X_2)^2}{n_2 - 1}}$$

$$s_1 = \sqrt{\frac{\sum X_1^2 - n_1(X_1)^2}{n_1 - 1}}$$

Where,

X_1 = is the mean of control group

X_2 = is the mean of experimental group

S_1 = standard deviation of control group

S_2 = Standard deviation of experimental group

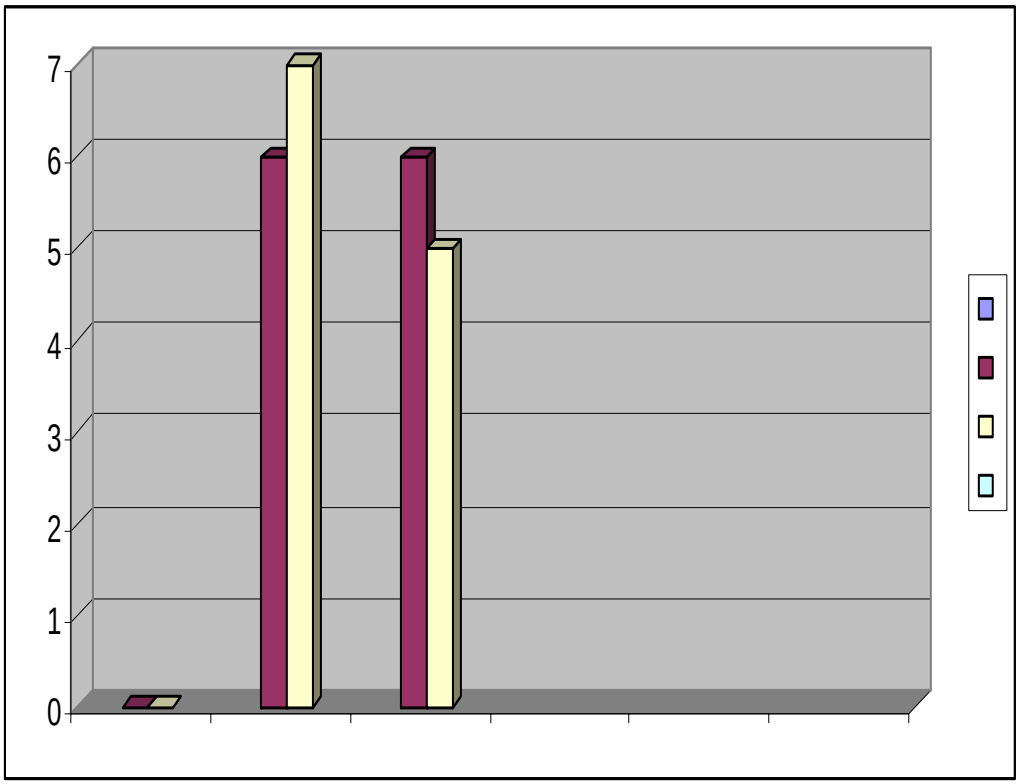
S = combined standard deviation

II. **DEMOGRAPHIC REPRESENTATION OF DATA**

Table1. Demographic representation of subjects

Group	Age	Gender		Side involved		Duration in month		
	Mean	Male	Female	Dominant	Nondominant	3-6	6-9	9-12
Experimental Group	52 SD ±8	6	6	5	7	7	2	3
Control Group	57 SD ±8	7	5	6	6	6	3	3

Figure 1. Gender distribution of subject



Male **Female**

Table 2. Age distribution of subjects

Age in years	40-50	50-60	60-70
No. of patients in experimental group	6	3	3
No. of patients in control group	4	3	5

Figure 2. Age distribution of subjects

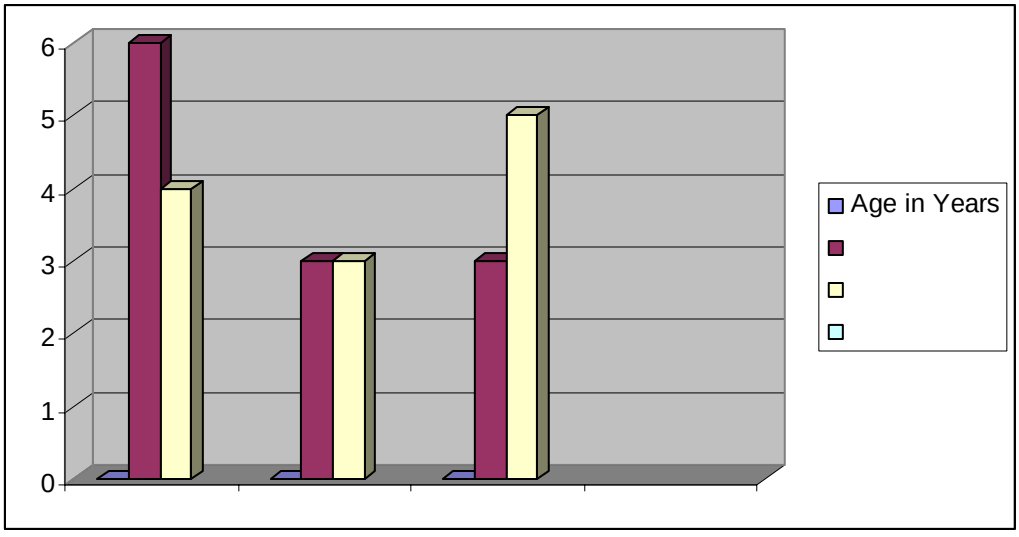


Figure 3. Distribution of side of dominance

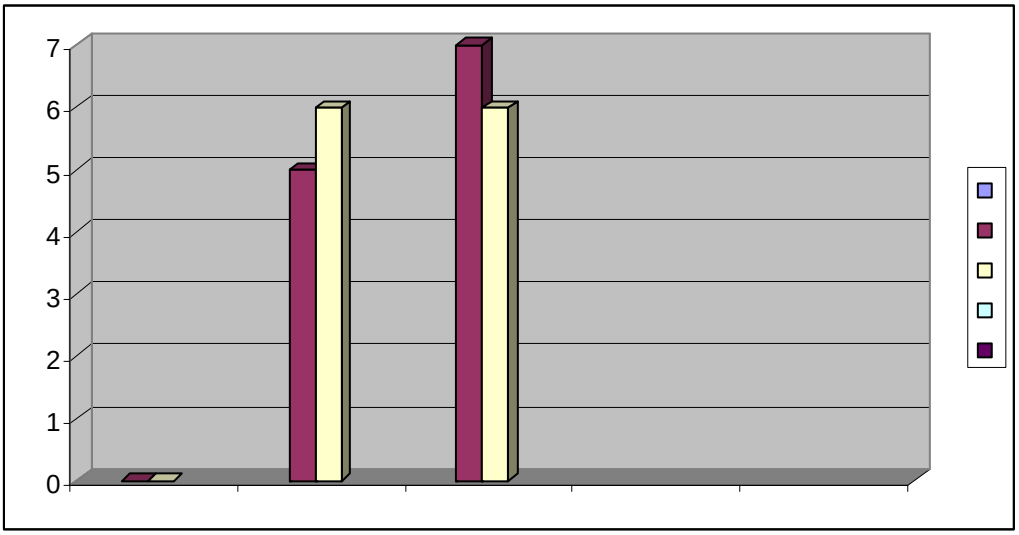
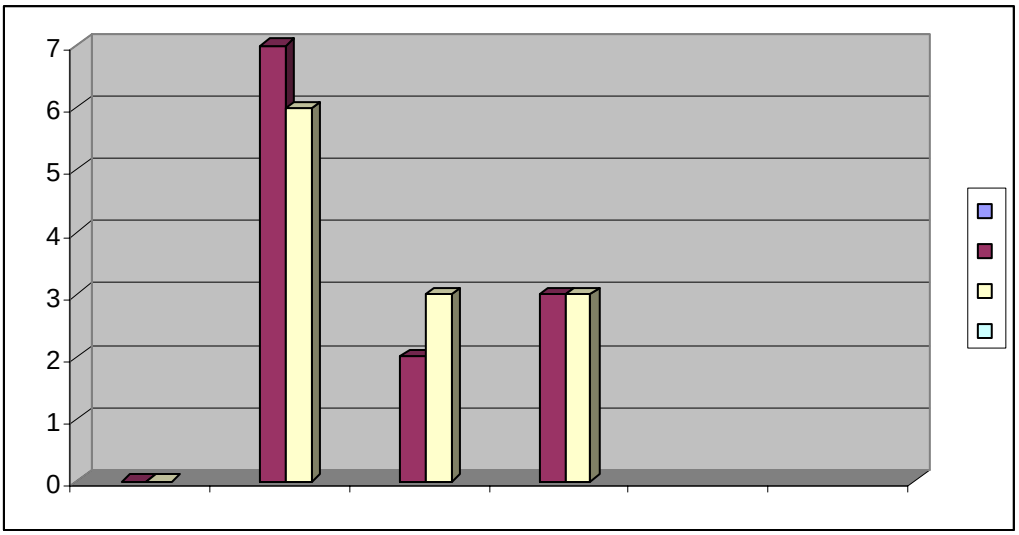


Figure 4. Duration of disease



III. RESULTS OBTAINED BY ANALYSING DATA

1. General features of the subjects

The experimental groups of 12 subjects, 6 were male and 6 were female and the mean age of the subjects was 52 years, 5 subjects had dominant side involvement while 7 had no dominant side involvement. Mean duration of condition was 5.7 months.

In control group out of 12 subjects, 7 were males and 5 were females. The mean age was 57 years. 6 subjects had dominant side involvement while 6 had no dominant side involvement. Mean duration of the condition was 6 months.

Subjects in both groups were analysed with chi square test to check whether there is any statistically significant difference in terms of age, (X2 = 0.9, table value, 5.99 at 0.05 level) Sex (x2 = 0.67, table 3.84 at 0.05 level) side of involvement (X2 = 0.67, table 3.84 at 0.05 level) and duration of condition. (X2 = 0.27, table value 5.99 at 0.55 level) and it was found to be non significant.

Table 3. Mean values of data assessed for the study

Visual Analogue scale

Group	Initial	Final	¯d	SD
Experimental	6.83	3	3.83	± 0.37
Control	6.41	3.35	3.08	±1.61

PROM Abduction

Group	Initial	Final	¯d	SD
Experimental	87.66	148.41	60.75	± 30.76
Control	91.08	127.41	36.33	± 26.62

PROM External Rotation

Group	Initial	Final	¯d	SD
Experimental	44.58	84.16	39.58	± 16.57
Control	47.5	69.25	21.75	±13.79

Shoulder Functional Score

Group	Initial	Final	¯d	SD
Experimental	64.5	89.58	24.83	8.13
Control	61.58	77.16	14.75	10.66

AROM Abduction

Group	Initial	Final	¯d	SD
Experimental	84.5	144.41	60.75	± 30.76
Control	86.08	122.41	36.33	± 26.02

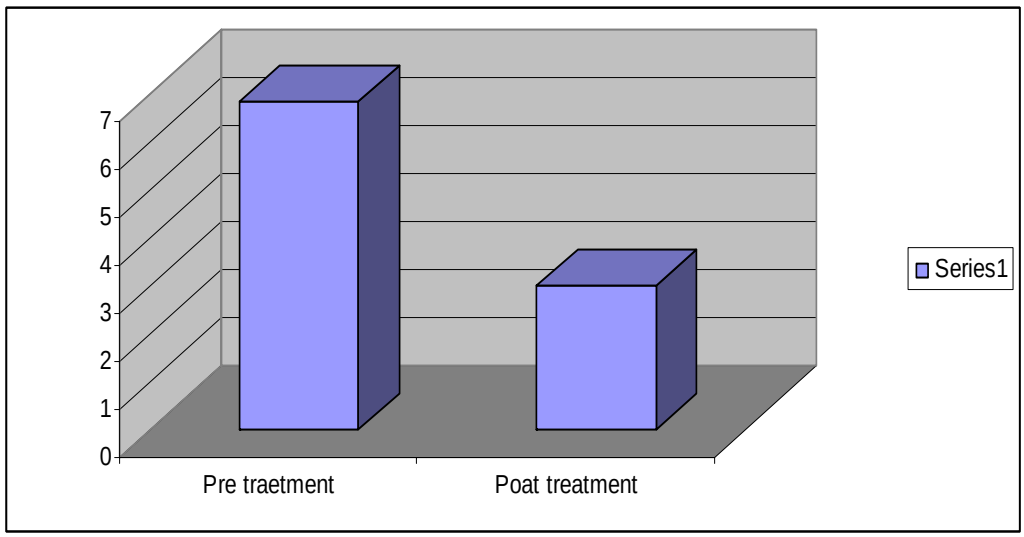
AROM External Rotation

Group	Initial	Final	¯d	SD
Experimental	40.58	80.16	39.58	± 16.57
Control	42.5	64.5	21.75	±13.79

IV. **ANALYSIS OF EXPERIMENTAL GROUP'S RESPONSE TO VAS**

The initial mean VAS reading was 6.83 and after treatment it was reduced to 3 showing a reduction of 38.3% in pain intensity. This indicates that treatment in experimental group was effective in reducing the pain in adhesive capsulate patients (The calculated 't' value is 9.87, table value is 1.79 at 0.05 level of significances.

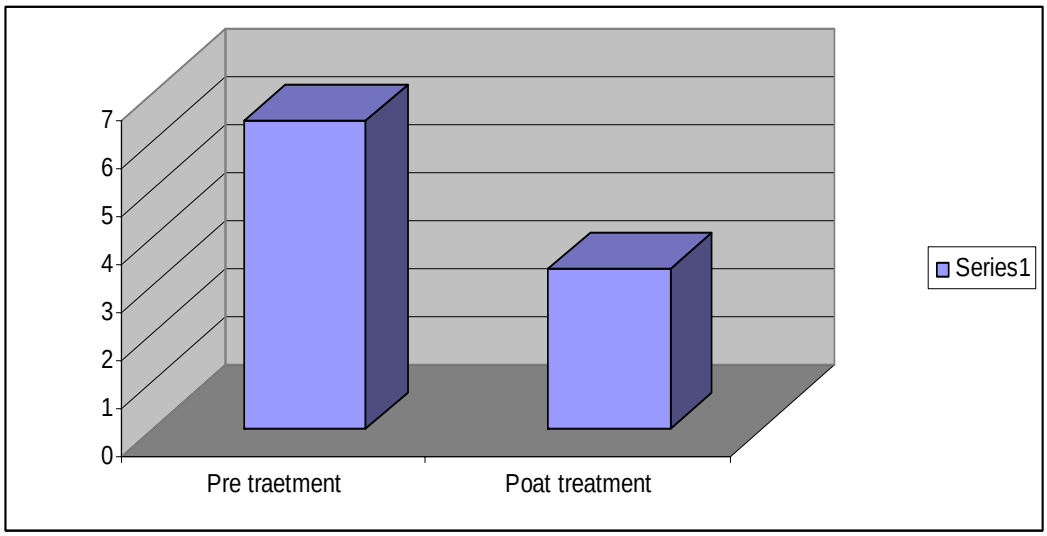
Figure 5. Experimental groups response to VAS



V. ANALYSIS OF CONTROL GROUP'S RESPONSE TO VAS

The initial mean reading was 6.41 and after treatment it was reduced to 3.33 showing a reduction of 30.8% in pain intensity. This indicates that treatment in control group was effective in reducing the pain in adhesive capsulitis patients (the calculated't' value is 6.57, table value is 1.79 at 0.05 level of significance).

Figure 6. Control group's response to VAS



VI. COMPARISON OF EXPERIMENTAL GROUP'S RESPONSE OVER CONTROL GROUP'S RESPONSE TO VAS

Both the treatments were effective in reducing the pain in adhesive capculitis patients. But when their response was compared between each other ther was no significant difference. This indicates that treatment with ultrasound in axillary method is not significantly effective over anterior method in reducing pain in adhesive capsulitis patients. Thus null hypothesis is accepted. (Calculated value is 1.23 tables are 2.07 at 0.05 level of significance).

Figure 7. VAS Score Experimental group Vs Control Group

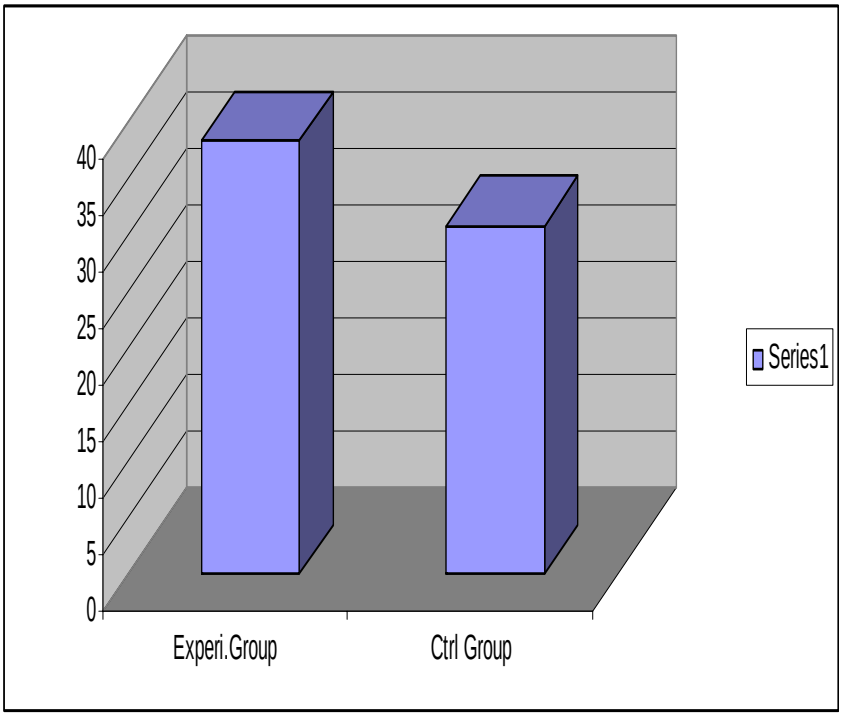


Table 4. Control group Vs Experimental group for pain reduction.

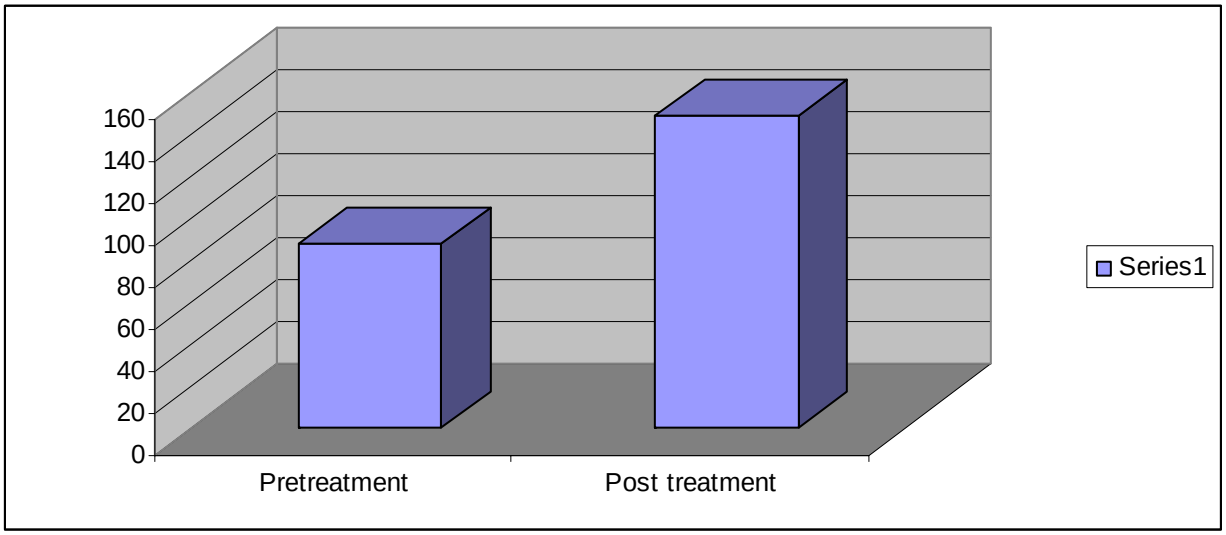
VAS	Intitial Score	Independent 't' value 2.07	Final score	Independent 't' value 2.07	Dependent 't' value
Exp.Gp	6.83	0.528 at 0.05 level of significance	3	1.23 at 0.05 level of significance	9.87 at 0.05 level of significance
Con. Gp	6.41		3.33		6.57 at 0.05 level of significance

VII. EXPERIMENTAL GROUP'S RESPONSE TO PASSIVE ABDUCTION RANGE

The initial mean abduction range was 87.66 and after treatment it was increased up to 148.41 showing an increment of 33.75%. This indicates that axillary's method of ultrasound application is effective in improving the passive abduction range in adhesive capsulitis patients.

(Calculated't' value is 6.83, table value is 1.7 at 0.05 level of significance).

Figure 8. Experimental group response to passive abduction range

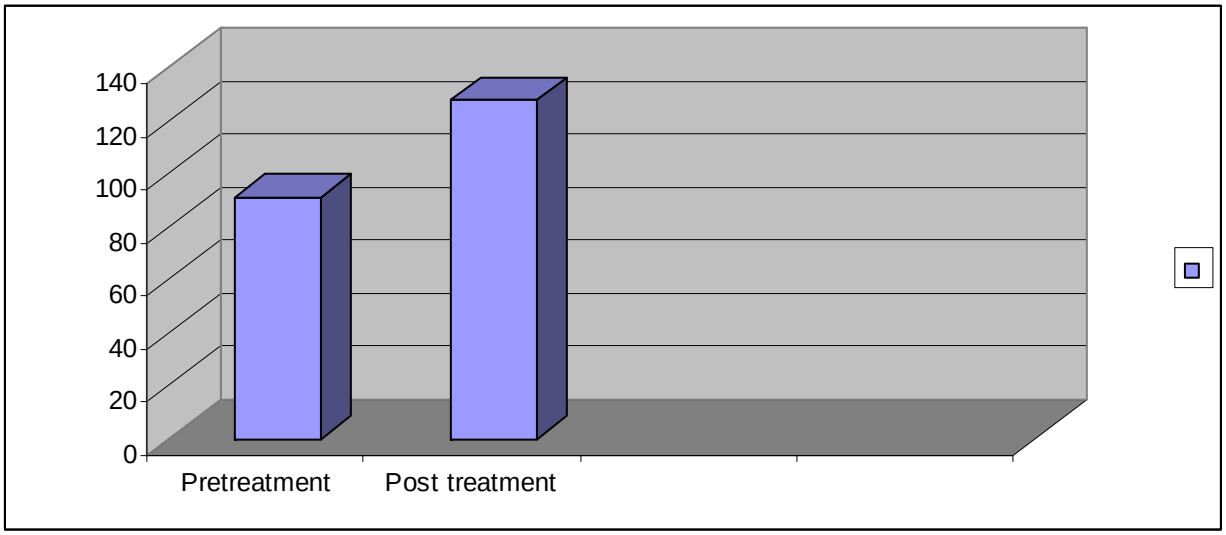


VIII. CONTROL GROUPS RESPONSE TO PASSIVE ABDUCTION RANGE

The initial mean abduction range was 91.08 and treatment it was increased up to 127.41 showing an increment of 20.18%. This indicates that treatment with anterior method of ultrasound application was effective in improving the passive abduction range of adhesive capculitis patients.

(Calculated‘t’ value is 8.72, table value is 1.7 at level of significance)

Figure9. Control group response to passive abduction



IX. COMPARISON OF EXPERIMENTAL GROUP'S RESPONSE OVER CONTROL GROUPS RESPONSE TO PASSIVE ABDUCTION RANGE

Even through both treatments showed significance improvement in gaining abduction range, when statistically analyzed, experimental group showed significant difference in gaining the range than the control group. This shows that axillary method of ultrasound application was effective in improving the passive abduction range than anterior method. Thus null hypothesis is rejected.

(Calculated 't' value is 2.092 table value is 2.07 at 0.05 level of significance)

Figure 10. Experimental group Vs control group for passive Abduction range

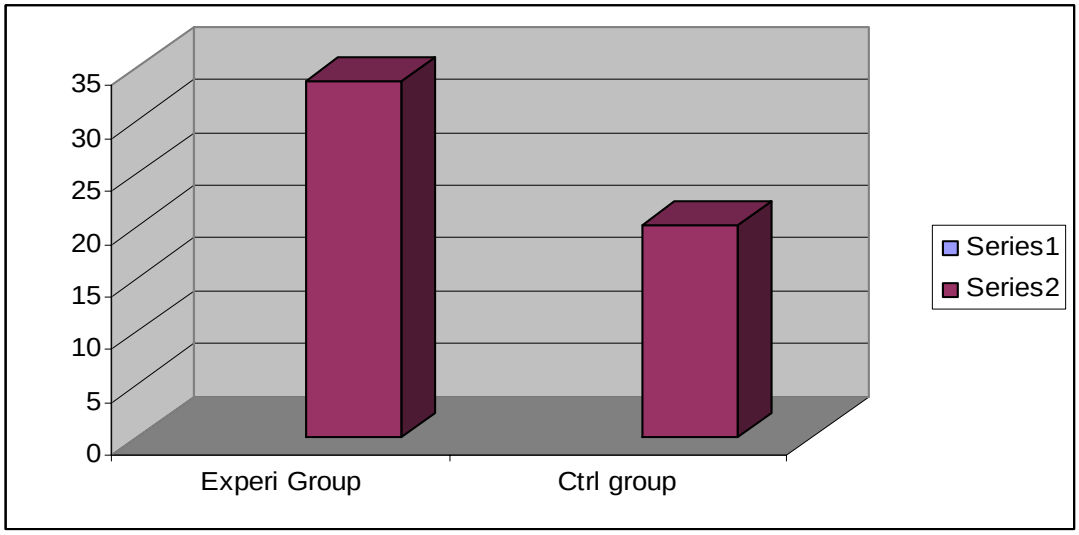


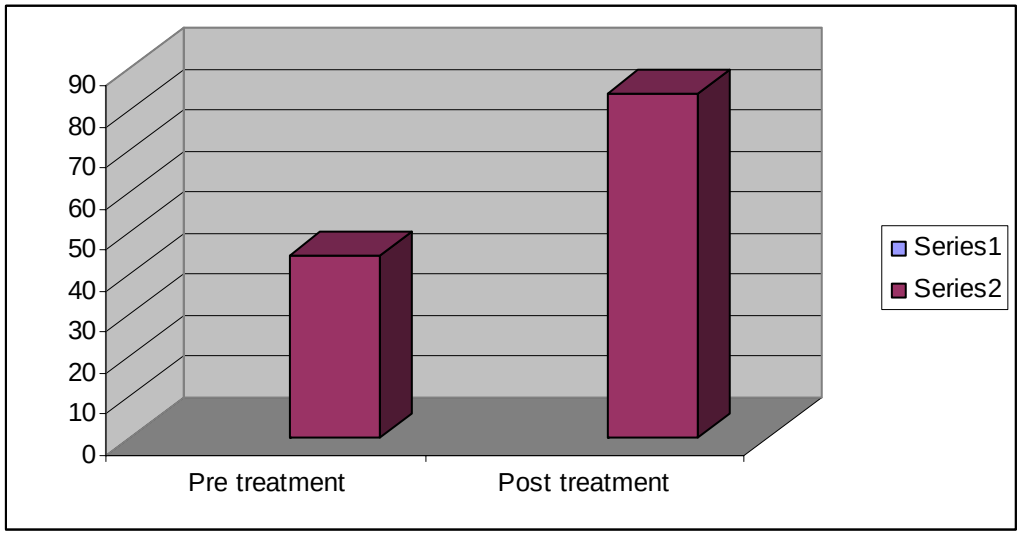
Table 5: Experimental group Vs control group passive Abduction range

PROM	Initial Score	Independent 't' value 2.07	Final score	Independent 't' value 2.07	Dependent 't' value
Exp.Gp	87.66	0.429 at 0.05 level of significance	140.41	2.092 at 0.05 level of significance	6.83 at 0.05 level of significance
Con. Gp	91.08		127.41		8.72 at 0.05 level of significance

X. EXPERIMENTAL GROUP'S RESPONSE TO PASSIVE EXTERNAL ROTATION

The initial mean passive external rotation range was 44.58 and after treatment it was increased to 84.16 showing an improvement of 43.97%. This indicates that axillary method of ultrasound application was effective in improving the external rotation range. (The calculated't' value is 5.45, table value is 1.79 at 0.05 level of significance).

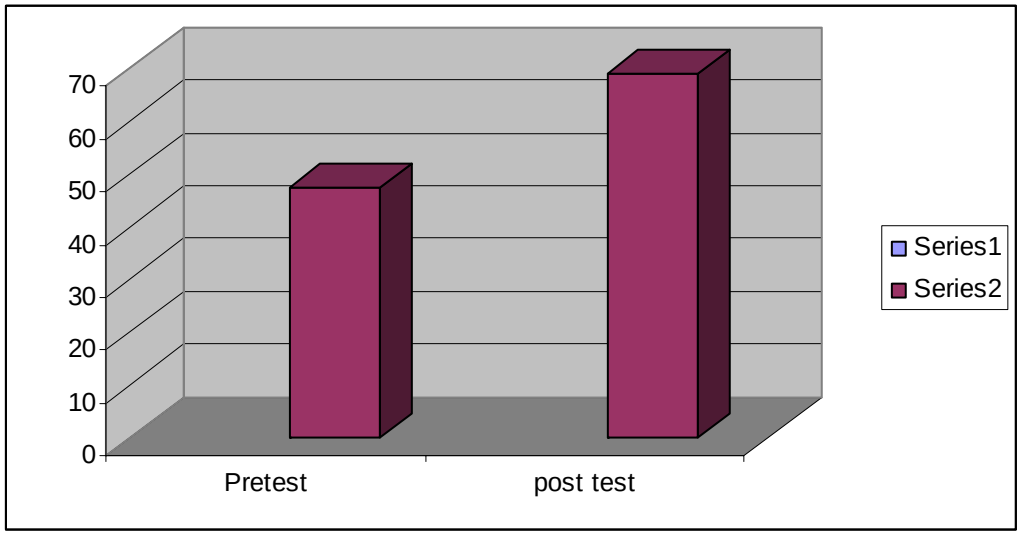
Figure 11. Experimental group response to passive external rotation range



XI. CONTROL GROUP'S RESPONSE TO PASSIVE EXTERNAL ROTATION RANGE

The initial mean passive external rotation range was 47.5 and after treatment it increased to 69.25, showing an improvement of 24.16%. This indicates that anterior method of ultrasound application if effective in improving the passive external rotation range in adhesive capsulitis patients. (Calculated't 'value is 5.45, table value is 1.79 at 0.05 level of significance)

Figure 12. Control group's response to passive external rotation range



XII. COMPARISON OF EXPERIMENTAL GROUP'S RESPONSE OVER CONTROL GROUPS RESPONSE TO PASSIVE EXTERNAL ROTRATION RANGE

Even through both groups showed significant improvement in gain in range, experimental group showed significant improvement than control group when they are compared between each other. This indicates that axillary method of ultrasound application was effective in improving passive external rotation range than anterior method. Thus null hypothesis is rejected.

(Calculated t value is 2.85 table is 2.07 at 0.05 level of significance)

Figure 13. Experimental group for passive external rotation range.

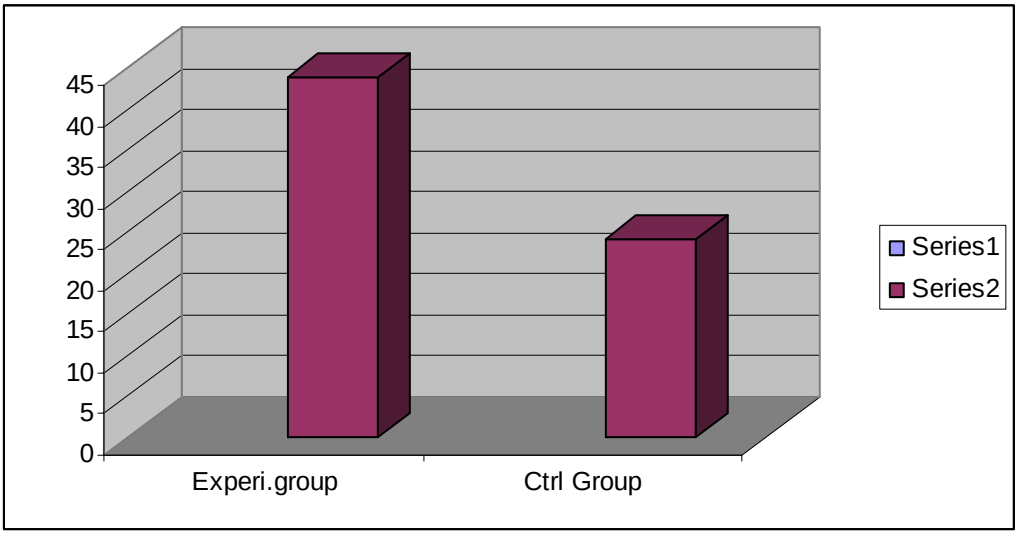


Table 6. Experimental group Vs control group passive external rotation range.

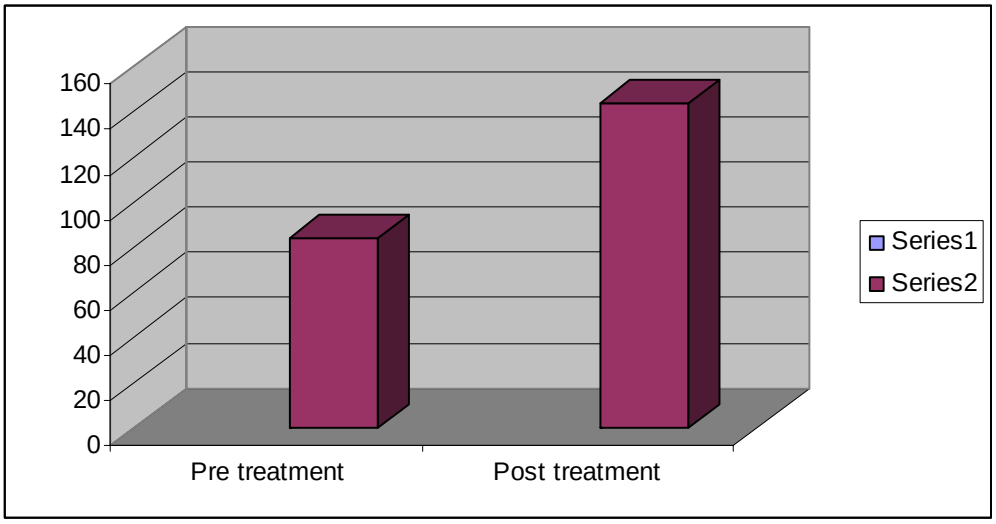
PROM Abduction	Initial Score	Independent 't' value 2.07	Final score	Independent 't' value 2.07	Dependent 't' value
Exp. Gp	44.58	0.55 at 0.05 level of significance	84.16	2.85 at 0.05 level of significance	8.26 at 0.05 level of significance
Con. Gp	47.5		69.25		5.45 at 0.05 level of significance

XIII. Experimental group's response to active abduction range

The initial mean range was 84.5 and after treatment it was increased up to 144.41 showing an improvement of 32.28%. This indicates that axillary method of ultrasound application is effective in improving active abduction range.

(Calculated value of't' is 6.85, table value is 1.7 at 0.05 level of significance)

Figure 14 Experimental group's response to active abduction range

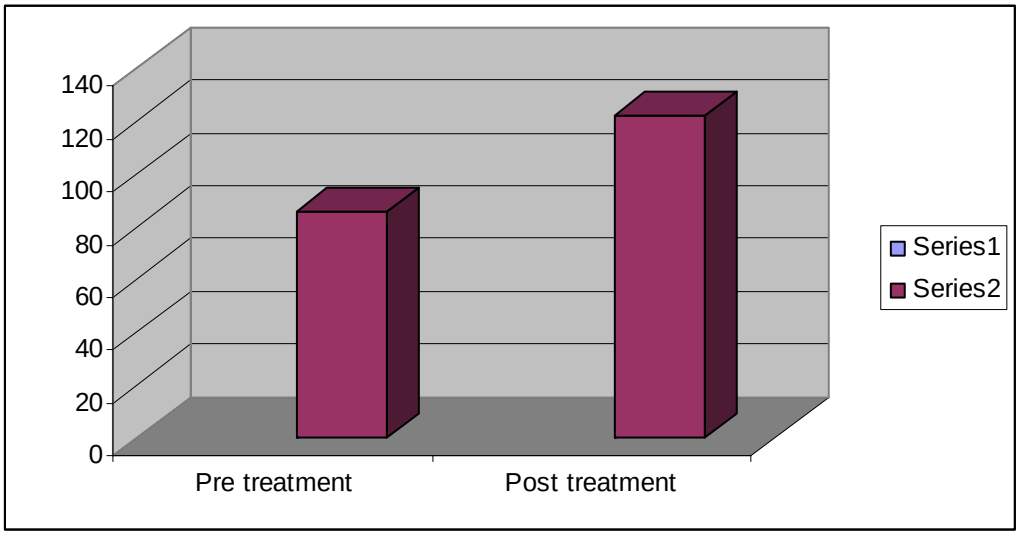


XIV. CONTROL GROUP'S RESPONSE TO ACTIVE ABDUCTION RANGE

The mean initial range was 86.08 and after treatment it was increased up to 122.41, showing an improvement of 20.18%. This indicates that anterior method of ultrasound application is effective in improving active range of abduction.

(Calculated't' value is 8.72, table value is 1.7, at 0.05 level of significance)

Figure 15. Control group's response to active abduction



XV. COMPARISON OF EXPERIMENTAL GROUP'S RESPONSE TO CONTROL GROUP'S RESPONSE IN ACTIVE ABDUCTION RANGE

Even through both groups showed gain in range the experimental group had a significant improvement in gaining range aver control group I.e., treatment with axillary method is effective than anterior method of ultrasound application in adhesive capsulitis patients.

(Calculated't' value is 2.43, table value is 2.07 at 0.05 level of significance).

Figure 16. Experimental group Vs control group for active abduction range

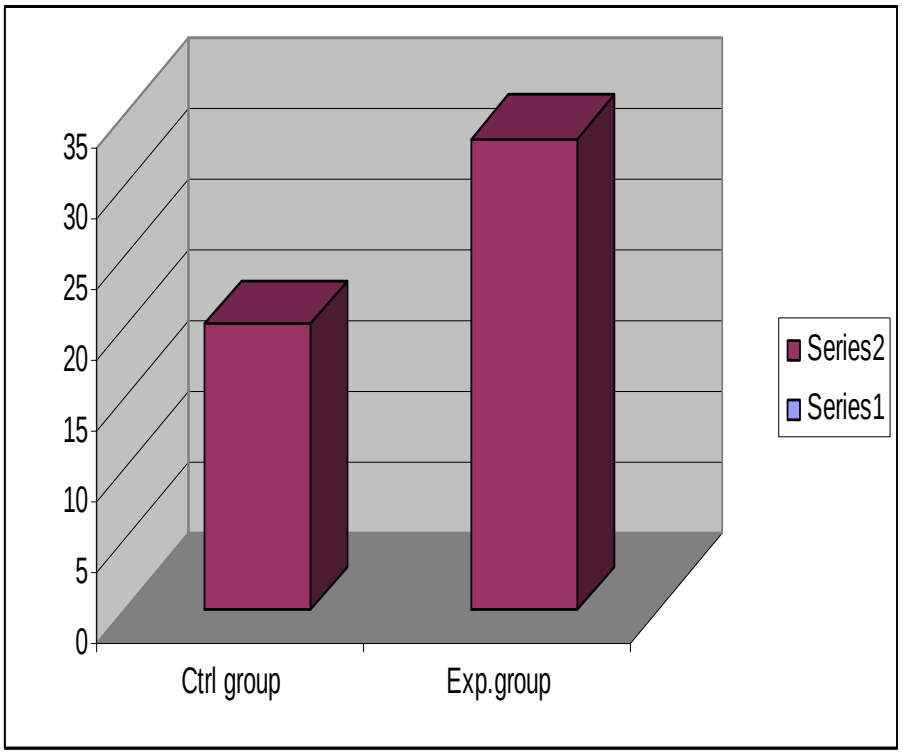


Table 7. Experimental group Vs control group for active abduction range

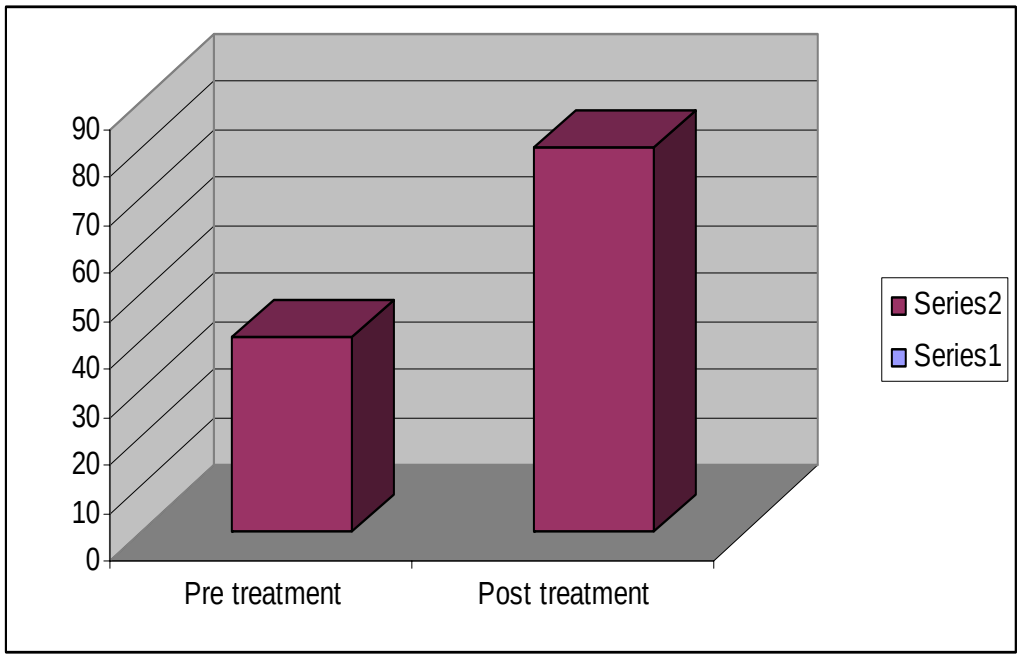
PROM Abduction	Initial Score	Independent 't' value 2.07	Final score	Independent 't' value 2.07	Dependent 't' value
Exp. Gp	84.5	0.29 at 0.05 level of significance	144.41	2.092 at 0.05 level of significance	6.85 at 0.05 level of significance
Con. Gp	86.08		122.41		8.72 at 0.05 level of significance

XVI. EXPERIMENTAL GROUP'S RESPONSE TO ACTIVE EXTERNAL ROTATION RANGE

The initial mean range was 40.58 and after treatment it was increased upto 80.16 showing an improvement of 43.97% . This indicates that treatment with axilla method is effective in gaining the active external rotation range in adhesive casulitis patients.

(Caculated 't' value is 8.26, table value is 1.7 at 0.05 level of significance.)

Figure 17. Experimental group's response to active external rotation range

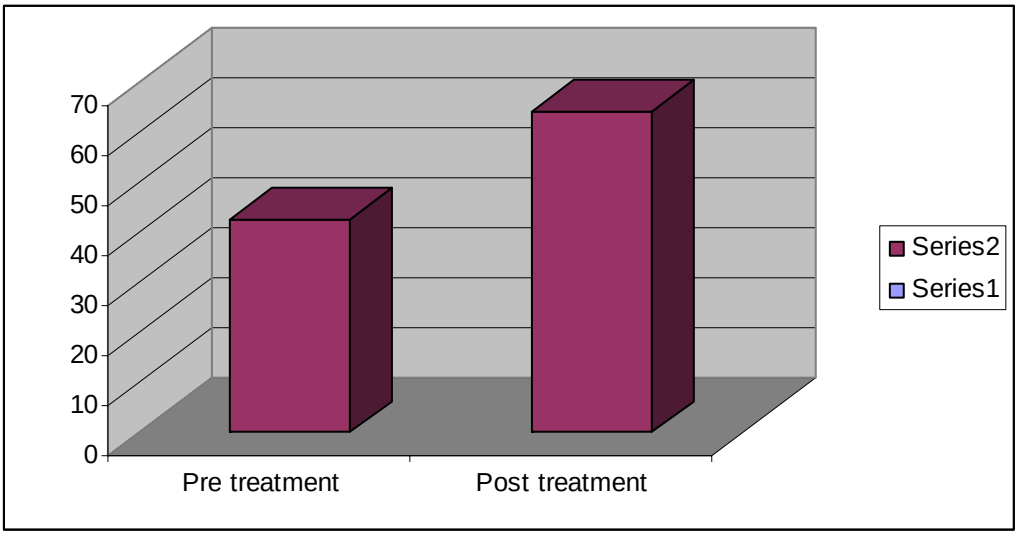


XVII. CONTROL GROUP'S RESPONSE TO ACTIVE EXTERNAL ROTATION RANGE .

The initial mean range was 42.5 and after treatment it was increased upto 64.25, showing an increment of 24.16%. Tis shows that anterior method is effective in gaining active external rotation range.

(Calculated 't' value 5.45, table value 1.79 at 0.05 level of significance)

Figure 18. Control groups response to active external rotation range.



XVIII. COMPARISON OF EXPERIMENTAL GROUP'S RESPONSE TO CONTROL GROUPS RESPONSE TO ACTIVE EXTERNAL ROTATION RANGE

Even though both group showed improvement in active external rotation range, experimental group had a significant improvement in gain or range over control group I,e., axillary method of ultrasound application is significantly effective than anterior method.

(Calculated't' value is 2,84, table value 2.07 at 0.05 level of significance)

Figure 19. Experimental group Vs control group for active external rotation range.

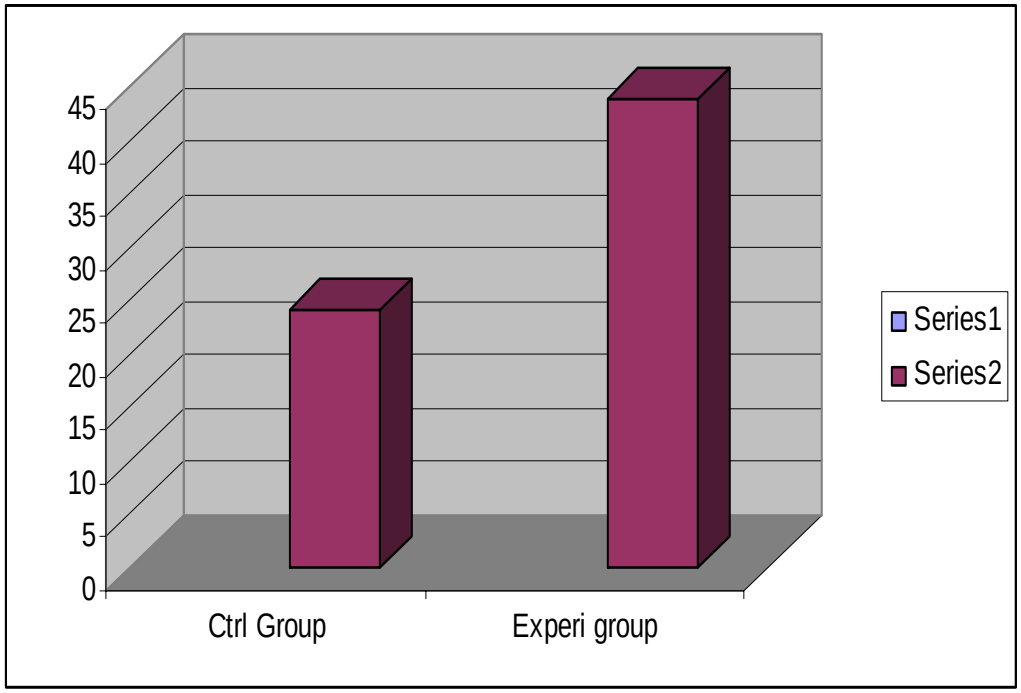


Table 8. Experimental group Vs control for active external rotation range.

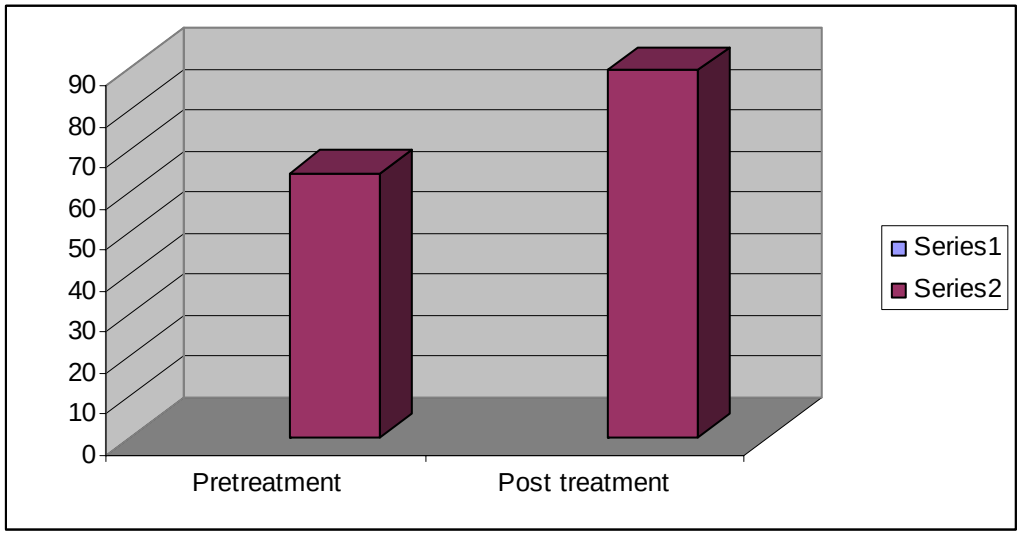
AROM Abduction	Initial Score	Independent 't' value 2.07	Final score	Independent 't' value 2.07	Dependent 't' value
Exp. Gp	40.58	0.367 at 0.05 level of significance	80.16	2.85 at 0.05 level of significance	8.26 at 0.05 level of significance
Con. Gp	42.5		64.25		5.45 at 0.05 level of significance

XIX. EXERIMENTAL GROUP'S RESPONSE TO SHOULDER FUNCTIONAL SCORE

The initial mean functional score was 64.5 and after treatment it was increased upto 89.58. Showing an increment of 25.08%. This indicates that axilliary method of ultrasound application in effective in improving the shoulder functional score of adhesive capsulitis patients.

(Calculated't' value is 10.55, table value is 1.79 at 0.05 level of significance)

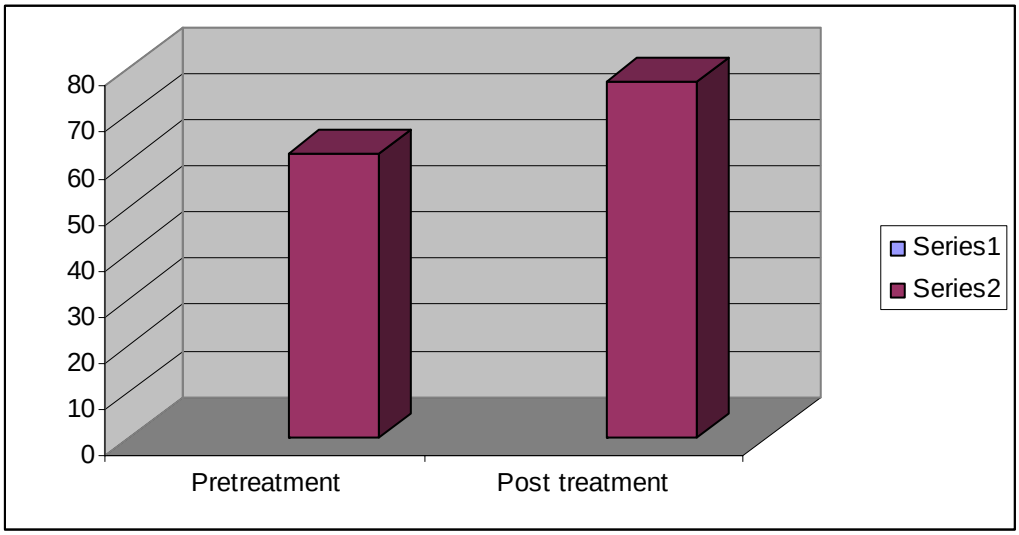
Figure 20. Experimental groups response to functional score



XX. CONTROL GROUP'S RESPONSE TO SHOULDER FUNCTIONAL SCORE

The initial functional score was 61.58 and after treatment it was increased to 77.16 showing an increment of 15.58. This indicates that anterior method of ultrasound application is effective in improving the shoulder functional score of adhesive capsulitis patients. (Calculated't' value is 4.78 table is 1.79 at 0.058 level of significance)

Figure 21. Control group's response to functional score



XXI. COMPARISON OF EXPERIMENTAL GROUP'S RESPONSE OVER CONTROL GROUP FOR SHOULDER FUNCTIONAL SCORE

Even though both showed improvement in functional score, the experimental group had significant difference over control group in gaining the improvement in shoulder functional score. Thus it can be said that treatment with axillary method of ultrasound application in significantly effective than anterior method in improving the shoulder functional score in adhesive capsulitis patients.

(calculated't' value is 2.53, table value is 2.07 at 0.05 level of significance)

Figure 22. Experimental group Vs control group for functional score

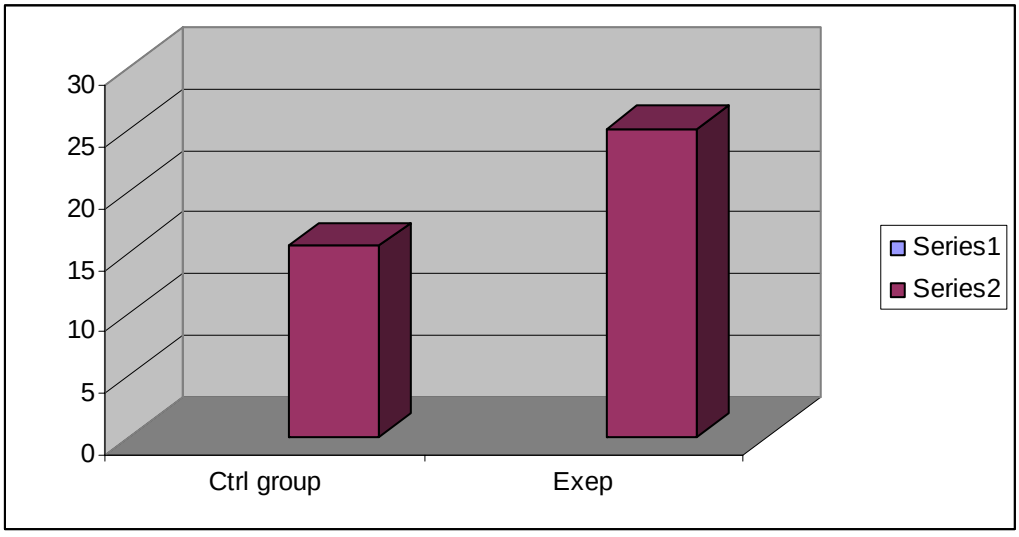


Table 9. Experimental group Vs Control for shoulder functional score.

Shoulder functional score.	Initial Score	Independent 't' value 2.07	Final score	Independent 't' value 2.07	Dependent 't' value
Exp. Gp	64.5	0.741 at 0.05 level of significance	89.58	2.59 at 0.05 level of significance	10.55at 0.05 level of significance
Con. Gp	61.58		77.16		4.78 at 0.05 level of significance

DISCUSSION

This study is a randomnised controlled trial to compare the effectiveness of axillary method of therapeutic ultrasound application over anterior method as an adjunct therapy in adhesive capsulitis of glenohumeral joint.

The analysis of active and passive abduction, active and passive external rotation and shoulder function score has revealed a significant improvement in experimental group who were treated with axillary method of ultrasound application prior to passive capsular stretching and active shoulder exercises. Analysis of pain reduction has revealed no significant improvement between these groups.

The results obtained after analysis shows that there is 13.75% increment in passive abduction 19.81% increment in passive external rotation 13.1% increment in active abduction, 19.81% increment in active external rotation, 25.08% increment in shoulder function score, which were statistically significant, thus accepting the alternate hypothesis. The results obtained after analysis of pain reduction shows 7.5% increment which is

statistically not significant, thus rejecting the null hypothesis. Hence the post analysis results shows the superiority of axillary method of therapeutic ultrasound application over anterior method in improving passive abduction, active abduction , passive external rotation, active external rotation and shoulder function in chronic adhesive capsulitis patients.

These greater results in experimental group with axillary method of ultrasound application as an adjunct therapy may be due to the following, reasons.

- Ultra sound concentration that reaches the capsule is higher in axillary method because there is no muscle overlying the capsule which has high ultrasound absorption coefficient.
- The contracted capsule is kept in a stretched position of maximum available pain free abduction and external rotation during the period of ultrasound application.
- Ultrasound application in mainly concentrated on the inferior axillary pouch which is supposed to be the seat actual defect.
- The localized deep heating effect of continuous ultrasound increases the extensibility of contracted capsule and helps in stretching and easy

breakage of adhesions ultimately contributing to normal joint function.

Hence axillary method is preferred over anterior method of therapeutic ultrasound application in chronic adhesive capsulitis patients. The need of a suitable pain relieving modality like TENS or IFT in the treatment protocol of adhesive capsulitis is also emphasized.

LIMITATIONSAND SUGGESTIONS

1. A related scientific study regarding the axillary method of ultrasound application was not available.
2. This is not a blinded study. A blinded study given more reliable results.
3. Sample size taken was small, hence to establish the efficacy of treatment a larger size study is required.
4. Limited parameters of outcome measure were used. Horizontal adduction, flexion, international rotation was not taken as an out come measure.
5. ROM as an outcome measure were were taken manually this way introduce human error which could threat the study's reliability. The use of radiological angle measurement to calculate the exact ROM may be used.
6. No follow ups could be done. If done it can ensure the long term effectiveness of the treatment.
7. A shoulder arthrogram or distension arthrogram was not done. If done it confirms the diagnosis with definitive involvement or obliteration of inferior axillary pouch.

8. Shaving of axillary region takes extra time and increases the risk of infection. All aseptic precautions to be taken.
9. No financial aid from the university.

SUMMARY

This randomized control trial study was conducted to compare the effectiveness of axillary method of therapeutic ultrasound application over anterior method in chronic adhesive capsulitis patients. 24 subjects were randomly divided into an experimental group and a control group 12 patients each. A detailed assessment of each patient was taken. The experimental groups of patients were treated with axillary method of ultrasound application, passive capsular stretching, active shoulder exercises and home programme for 10 days. The control group is also given the same treatment except that ultrasound is given in anterior method. The results of treatment were measured using out come measures of pain reduction. Active abduction, passive abduction, active external rotation, passive external rotation and shoulder function score. The experimental groups of patients who were treated with axillary method of ultrasound application were shown significant improvement in all out come measures except in pain reduction.

CONCLUSION

Conclusion of this study provides that axillary method gives better results than anterior method of therapeutic ultrasound application as an adjunct therapy in chronic adhesive capsulitis of glenohumeral joint interms of active and passive abduction, active and passive external rotation and shoulder function, while pain reduction remains unaltered. In this context the axillary method is recommended for therapeutic ultrasound application in chronic adhesive capsulitis patients. The need of a suitable pain relieving modality in the treatment protocol of adhesive capculitis is also emphasised.

REFERENCES

1. Turek's Orthopaedics, Principles and their application fifth edition. Staurt. L., Weinstein MD, Joseph A. Burkwalter M.D.
2. Clinical Orthopaedic Diagnosis. Second edition Sureshwar Panday and Anil Kumar Panday.
3. The Principles of Exercise Thera[py, Forth edition M. Dena Gardiner.
4. Physical therapy of the shoulder. Third edition. Robert A Donatelli, Ph.D, PT, OCS.
5. Physical agents in Rehabilitation – From Research to practice. Michelle H. Cameron PT. OCS.
6. Essentials of orthopaedics and Applied physiotherapy, Jayant Joshi and Prakash Kotwal.
7. Tidy's physiotherapy Twelth edition.
8. Orthopaedic physical Therapy, Donatelli.
9. Joint structure and function. A comparative Analysis second edition, Cynthia C. Narkin, Edp. PT, Pamela K. Levargie MS, PT.
10. Therapeutic Exercise, Foundations and techniques. Third edition – Carolyn Kisner MS, PT, Lynn Alten Colby MS, PT.
11. Shoulder pain. Pain series. Rene Calliet M.D., third edition.

12. Apley's system of orthopaedics and fractures. 7th edition Butterworth Heineman.
13. Text book of orthopaedic medicine 7th edition, Vol. 1, Bailliere Tindrall.
14. Cash's textbook of orthopaedics and rheumatology for physiotherapists. Downepaticia.
15. Physiology og joints, 2nd edition, Kapandji I.A
16. Frozen shoulder Diagnosis and Management, Warmer JJ.
17. Clinical Kinesiology, Brunnstrom, 5th edition. Laura K. Smith, Elizabeth L., Weiss, L. Don Lehmkuhi.
18. The injred athlete, 2nd edition, David N. Kulund.
19. Textbook of Anatomy JSP Lumley.
20. Functional Anatomy of the limbs and back. 6th edition Jekins.
21. American Physical Therapy Association Journal 2001. Vol.80
22. American Physical Therapy association Journal. 200.Vol.78